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Original Article

Acute toxicity of Diazinon to the Caspian vimba, *Vimba vimba persa* (Cypriniformes: Cyprinidae)

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Abstract: The present research was performed to determine lethal concentrations of diazinon for the Caspian vimba, *Vimba vimba persa*. Fish samples (50 ± 5 g) collected from Sefidroud river were acclimatized for 5 days and exposed to 5 concentrations of diazinon, 0.07, 0.08, 0.1, 0.13 and 0.16 mg/l (with three replicates) and lethal concentrations (LC) LC_1, LC_{10}, LC_{30}, LC_{50}, LC_{70}, LC_{90} and LC_{99} for 24, 48, 72 and 96 h were determined using a probit analysis. The results indicated that the 96 h LC_{50} value of diazinon for Caspian Vimba was 0.08 mg/l.

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Introduction

Organophosphate pesticides are a major group of chemical insecticides being used widely throughout the world (Garfitt et al., 2002) in agriculture, gardening, pest control, residential areas for protection of public health, veterinary and industry (Bonilla et al., 2008). These insecticides frequently enter into surface water and groundwater through drainage from agricultural fields (Sohrabi et al., 2001). Diazinon is one of the most frequently used organophosphate insecticides for control of insects in agriculture. It becomes degraded rapidly in the aquatic environment. Its half-life, in aerobic mineral soils, may be more than one month (Garfitt et al., 2002; Ahmadi et al., 2011). Although diazinon is rapidly degraded, it may remain biologically active in the soil up to six month and even more under certain conditions such as low temperature, low humidity, high alkalinity and lack of active microbial decomposers (Eisler, 1986). Diazinon enters into aquatic ecosystem in large quantities and affects non-target organisms (Burkepile, 2000; Maxwell and Dutta, 2005).

Diazinon has been detected in significant amount in many coastal, deltaic and surface waters and also in municipal wastewater treatment plants around the world, including Iran (Shayeghi et al., 2001; U.S. EPA, 2005). It has been detected in some drainage of rice fields in north of Iran (Nouri et al., 2000; Tavakol, 2007) and Mahabad, Simine (Honarpajouh, 2003), Nahand (Tarahi Tabrizi, 2001), Kor, Sivand, Shahpoor, Mand, Dalki (Shayeghi et al., 2007), Gorgan, Gharesoo (Bagheri, 2007), Karaj river and most of Mazandaran rivers (Shayeghi et al., 2007; Arjmandi et al., 2010). Once entered into surface waters, even low doses of diazinon can cause several adverse effects in fish such as neurological impairment and abnormalities in gills, impairment in immune system, olfactory system and reproductive behavior, damage to ovary and testis and delay in

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Table 1. Lethal concentrations of Diazinon for Caspian *vimba*.

	Concentration (mg/l)			
Points	24 h	48 h	72 h	96 h
LC_1	0.01	0.06	0.04	0.007
LC_{10}	0.16	0.1	0.07	0.04
LC_{30}	0.28	0.12	0/09	0.06
LC_{50}	0.36	0.14	0.1	0.08
LC_{70}	0.44	0.16	0.12	0.1
LC_{90}	0.55	0.19	0.14	0.12
LC_{99}	0.71	0.23	0.17	0.16

sexual maturity (Eisler, 1986; Moore and Waring, 1996; Dutta et al., 1997, Dutta and Maxwell, 2003; Dutta and Meijer, 2003, Dutta et al., 2006). LC_{50} of diazinon is highly variable, and depends on the age, weight, and genus of fish and the environmental conditions. It affects sexual hormones, increases LH and FSH level and decreases testosterone levels significantly in mice (Fattahi et al., 2009).

Vimba vimba is valuable species of cyprinid family (Schweyer et al., 1991) and lives in the Caspian Sea, Black Sea and eastern part of the North Sea. In Iran, Caspian Vimba is distributed in the southern Caspian Sea from the Anzali lagoon to the Gorgan River. Based on IUCN classification the Caspian Vimba (*Vimba vimba persa*) is a threatened species in the Caspian sea (Kiabi et al., 1999) and today the fish needs protection because of significant decline in stock, over fishing and destruction of habitat (Jolodar and Abdoli, 2004). The purpose of this research was to determine acute toxicity of diazinon to *Vimba vimba persa*.

Materials and methods

Experiments were performed according to the OECD standard method (OECD, 1989), to determine 96 h LC_{50} of diazinon to Caspian Vimba. For these experiments 90 fish with an average weight of 50 ± 5 g were collected from Sefidroud river and were acclimatized for 5 days, then divided into five treatments and one control (with three replications) in same aquaria (30 × 40 × 70 cm). Physicochemical properties of water used for these experiments were as follows: 23 ± 1°C temperature, 7 to 9.5 mg/L dissolved oxygen, 6.5 to 8 pH and 220 mg/l total hardness. During the experiment, water was not exchanged. Before the test, fish were fed twice daily with Biomar feed at 2% body weight. Five concentrations of diazinon used were 0.07, 0.08, 0.1, 0.13 and 0.16 mg/l. The nominal concentration of diazinon causing 50% mortality of Caspian Vimba within 24 h (24 h LC_{50}), 48 h, 72 h and 96 h was determined using probit analysis in the software SPSS 16.

Results

Values of different lethal concentrations of diazinon for 24-96 h to Caspian Vimba have been presented in Table 1. The results show that 96h LC_{50} value of diazinon for Caspian Vimba is 0.08 mg/l.

Discussion

Contrasting results are available on acute toxicity of diazinon to fish. Tumer (2002) observed 96 h LC_{50} values for some freshwater teleost greater than 90 mg/l. On the contrary 96 h LC_{50} values of diazinon for *Acipenser persicus*, *Acipenser stellatus* and *Acipenser nudiventris* were determined as 4.38, 2.54 and 0.36 mg/l, respectively (Pazhand, 1999; Shamooshaki, 2005) and those for *Rutilus frisii kutum*, *Hypophthalmichthys molitrix* and *Abramis brama* were determined respectively as 0.34, 1.9 and 1.8 mg/l (Nasri Tajan, 1997). Compared to these researches, *Vimba vimba* is considered as highly sensitive and vulnerable to diazinon. 96 h LC_{50} value of diazinon to Caspian vimba is even much lower than the sub lethal levels of diazinon (0.3 to 3.2

mg/L) that reduce emergence of stream insects cause potential mutagenicity in freshwater fish and spinal deformities in fish (Eisler, 1986).

References

Ahmadi S., Jafari M., Asgari A.R., Salehi M. (2011). Acute effect of Diazinon on the antioxidant system of rat's heart tissue. Kowsar Medical Journal, 16(2): 87-93.

Arjmandi R., Tavakol M., Shayeghi M. (2010). Determination of organ phosphorus insecticide residues in the rice paddies. International Journal Environmental Science Technology, 7: 175-182.

Bagheri F. (2007). Study of pesticide residues (Diazinon, Azinphosmethyl) in the rivers of Golestan Province (Gorganroud and Gharehsou), M.Sc. Thesis, Tehran University of Medical Science. Tehran, Iran.

Bonilla E., Hernandez F., Corte S.L., Mendoza M., Mejla J., Carrillo E. (2008). Effects of the insecticides marathon and diazinon on the early oogenesis in mice in vitro. Environmental Toxicology, 23(2): 240-245.

Burkepile D.E., Moore M.T., Holland M.M. (2000). The susceptibility of five nonmarket organisms to aqueous diazinon exposure. Bulletin of Environmental Contamination Toxicology, 64: 114-121.

Dutta H.M., Meijer H.J.M. (2003). Sub lethal effects of diazinon on the structure of the testis of bluegill, *Lepomis macrochirus*: a microscopic analysis. Environmental Pollution, 125: 355–360.

Dutta H.M., Maxwell L. (2003). Histological examination of sublethal effects of diazinon on ovary of Bluegill, *Lepomis macrochirus*. Environmental Pollution Journal, 121: 95-102.

Dutta H.M., Munshi J.S.D., Roy P.K., Singh N.K., Adhikari S., Killius J. (1996). Ultra structural changes in the respiratory lamellae of the catfish, *Heteropneustes fossils*, after sub lethal exposure to malathion. Environmental Pollution Journal, 92: 329–341.

Dutta H.M., Qadri N., Ojha J., Singh N.K., Adhikari S., Datta Munshi J.S., Roy P.K. (1997). Effect of diazinon on macrophages of bluegill sunfish, *Lepomis macrochirus*: a cytochemical evaluation. Bulletin of Environmental Contamination and Toxicology, 58: 134-141.

Fattahi F., Parivar K., Jorsaraei S.G.A., Moghadamnia A.A. (2009). The effect of diazinon on testosterone FSH and LH levels and testicular tissue in mice. Iranian Journal Report Medical Sciences, 7(2): 59-64.

Garfitt S.J., Jones K., Mason H.J, Cocker J. (2002). Exposure to the organophosphate diazinon: datagram human volunteer study with oral and dermal doses. Toxicology Letters, 134(1-3): 105-113.

Honarpajouh K. (2003). Study and Identification of OP pesticides residues (Azinphosmethyl and Diazinon) in the Mahabad and Siminerood Rivers, M.Sc. Thesis, Tehran University of Medical Science. Tehran, Iran.

Jolodar M.N., Abdoli A. (2004). Fish species atlas of South Caspian basin (Iranian waters). Iranian Fisheries Research Organization, Tehran.

Kiabi B.H., Abdoli A., Naderi M. (1999). Status of the fish fauna in the south Caspian basin of Iran. Journal of Zoology in the Middle East, 18: 57-65.

Maxwell B.L., Dutta H.M. (2005). Diazinon-induced endocrine disruption in bluegill sunfish, *Lepomis macro* Chris, Ecotoxicology and Environmental Safety, 60: 21-27.

Moore A., Waring C.P. (1996). Sub lethal effects of the pesticide diazinon on olfactory function in mature male Atlantic salmon parr. Journal of Fish Biology, 48: 758–775.

Nasri Tajan M. (1997). Determination of lethal concentration of toxin (Organophosphate insecticide), diazinon granule 5 percent and emulsion 60 percent on the *Abramis brama* population in Anzali lagoon. MSc thesis. Lahijan Islamic Azad University, pp: 7-31.

Nouri J., Arjmandi, R., Bayat H. (2000). Ecological investigation of application of pesticides in rice fields. Iran Journal Public Health, 29: 137-146.

OECD Guideline for testing of chemicals. 1989. Adopted by the Council.

Pazhand Z. (1999). Determination of lethal concentrations LC50 96h of the pesticides butachlor and diazinon on acipenserid fry (*A. persicus* and *A. stellatus*). M.Sc Thesis, Lahijan Azad University, pp: 9-20.

Schweyer J.B., Allardi J., Dorson M. (1991). Capture dans le Rhin de représentants des espéces *Aspius aspius* (Linné 1758) et *Vimba vimba* (Linné 1758). Bulletin Francais De La Peche Et De La Pisciculture, 320: 38-42.

Shamooshaki M.N. (2005). Determine the lethal concentration LC_{50} 96 h of heavy metals: Lead, zinc, cadmium and pesticides: Diazinon, Hinosan and Tilt on *Acipencer nudiventris* fry. MSc Thesis, Lahijan Azad University, pp: 1-4.

Shayeghi M., Darabi H., Abtahi H., Sadeghi M., Pakbaz F., Golestaneh S.R. (2007). Assessment of persistence and residue of diazinon and malathion in three rivers (Mond, Shahpour and Dalaky) of Bushehr Province; 2004-2005. Iranian South Medical Journals, 10: 54-60.

Shayeghi M., Shahtaheri S.J., Selseleh M. (2001). Phosphorous insecticides residues in Mazandaran River Waters, Iran. Iran Journal Public Health, 30: 115-118.

Sohrabi T., Hosseini A., Talebi K. (2001). Tail water quality changes in the rice-paddies of Guilan and Foumanat. Agriculture and Natural Resource, 5(1): 1-15.

Tarahi Tabrizi S. (2001). Study of pesticide residues (diazinon, malathion, metasytoux) in the Tabriz Nahand River. M.Sc. Thesis, Tehran University of Medical Science, Tehran, Iran.

Tavakol M. (2007). Environmental impact assessment of diazinon in rice fields (a Case Study on Amol Township Rice Fields), M.Sc. Thesis, Science and Research Branch, Islamic Azad University, Tehran, Iran.

Tumer L. (2002). Diazinon analysis of risks to endangered and threatened Salmon and Steelhead. Environmental Field Branch Office of Pesticide Programs, 125 p.

U.S. EPA. (2005). Office of science and technology Washington, DC. Aquatic life ambient water quality criteria diazinon final. (CAS Registry Number 333-41-5).